MALAISE TRAPS: THE TOWNES MODEL CATCHES MORE INSECTS

Robert W. Matthews and Janice R. Matthews
Department of Entomology, University of Georgia
Athens, GA 30602

ABSTRACT

Malaise traps of the Townes 1972 design captured 10 times as many insects as a commercial Cornell model during a four week test near Albany, New York in July 1977. Small changes in trap location resulted in significant differences in capture efficiency.

INTRODUCTION

In 1962, Henry Townes published the construction plans for a Malaise trap for capturing flying insects (Townes, 1962). Traps of this design were subsequently used successfully the world over in diverse situations, and his paper did much to attract the attention of entomologists to the potential of the trap as a sampling and collecting device. Ever working to improve trap collecting efficiency, Townes worked out a new pattern for a much lighter, more efficient trap that was easier to construct (Townes, 1972). Many uses of the Malaise trap or variations of it have appeared in the literature, some for rather specialized situations or sampling protocols (see Steyskal, 1981).

Various authors have stressed the importance of Malaise trap placement (e.g. Gressitt and Gressitt, 1962; Matthews and Matthews, 1970, 1971), but Townes, perhaps more than anyone, was aware of the influence of trap design on collecting efficiency. As he stated (Townes, 1972) " ..there is much difference between a good design and a poor one. A poorly designed trap may catch only a tenth of the catch of a better one of the same size, but its inferiority may be unsuspected until it is directly compared with the better trap."

Over the years, we have used a number of homemade and commercially produced Malaise traps. Always, our subjective impression was that the Townes traps were superior. However, to our knowledge no comparisons of the relative collection efficiency of alternative trap designs have been published. In summer 1977, we had the opportunity to directly compare the 1972 Townes trap with a commercially produced trap. We here summarize the results of this study. It is a particular pleasure to dedicate this paper to Henry Townes on the occasion of his 70th birthday. Through the years a substantial proportion of the parasitic wasps in research collections have been obtained through the use of Malaise traps, and Henry Townes, by his enthusiasm for these traps, has done more than anyone else to improve and popularize their use.

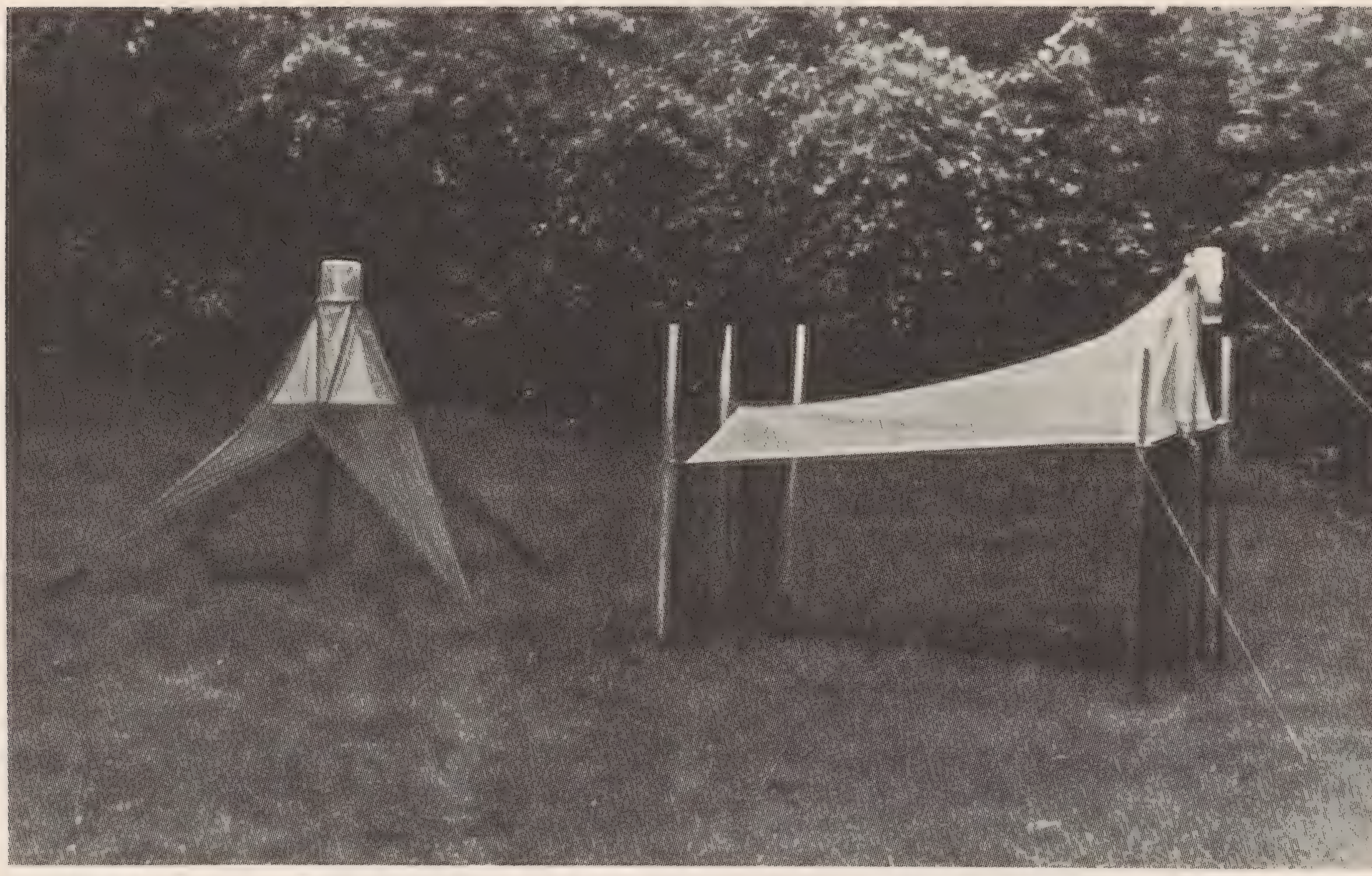

Figure 1. The two Malaise traps used in this study. Left, the nylon khaki-colored, commercially produced Cornell trap, with openings in four directions. Right, the bidirectional Townes 1972 trap made of dacron marquisette. Corner posts are 140 cm tall.

METHODS

For four weeks during July 1977 (July 1-28) we operated Malaise traps at two locations in the E. N. Huyck Preserve, Rensselaerville, New York. The research reported here was part of a larger study comparing changes in insect fauna over a decade. Thus, traps were set up in the identical spots where Traps 1 and 2 were located in 1967 (Table 1, Matthews and Matthews, 1970). At each location, a Townes 1972 model trap was placed beside a commercially available Cornell-type trap.[1] Both are non-attractant, interceptive devices that capture free-flying insects. They differ in shape, arrangement of openings, fabric, and color (Fig. 1). The Townes trap we constructed was 10% smaller than the directions specified, but the materials and coloration were faithfully followed. The Cornell trap collected from four directions, sampling a total air space of 4.0 m^2 (1.0 m^2 per opening). Our Townes trap sampled an air space of 1.5 m^2 from each of two directions. Thus, the total air space sampled by the Townes trap was about three-fourths that of the Cornell trap. Once each week, the positions of the two traps in each location were switched to control for trap placement effects. All traps used were in their second or third season of operation.

[1]Manufactured by Cornell Equipment Co. Inc., 1115 N. Rolling Rd., Baltimore, Maryland 21228

RESULTS

The 4 traps collected 69,247 insects over the 4 weeks of the experiment (Table 1), the Townes traps accounting for just over 90% of this total. The Townes traps caught over ten times as many Diptera, almost six times as many Hemiptera, and three and one-half times as many Lepidoptera as the Cornell traps. Similarly, the Townes traps caught 88.7% of all Hymenoptera obtained during the study. The two trap types caught roughly equivalent percentages of the various hymenopteran taxa, however. Ichneumonidae accounted for approximately 61% and Braconidae, approximately 28%.

Although traps were placed side by side, the alternate positions at each site were not equivalent (Table 2). For three of the four comparison pairs, the differences in numbers of insects caught were highly significant; only the Cornell trap at the woods site caught equal numbers of insects in the two alternate positions.

TABLE 1. TOTAL CATCHES OF COMMERCIAL CORNELL AND TOWNES MALAISE TRAPS COMPARED FOR PAIRS OF TRAPS AT TWO LOCATIONS FOR FOUR WEEKS. FOR ADDITIONAL DETAILS SEE TEXT.

Taxon	Trout Pond		Ash Woods		Overall
	Commercial	Townes	Commercial	Townes	Totals
Diptera	4,204(74.4%)	34,425(83.2%)	712(56.9%)	16,265(77.6%)	55,606
Hemiptera	435 (7.8%)	2,385 (5.8%)	34 (2.7%)	347 (1.7%)	3,201
Lepidoptera	480 (8.5%)	1,437 (3.5%)	149(11.9%)	726 (3.5%)	2,792
Hymenoptera	361 (6.4%)	1,792 (4.3%)	270(21.6%)	3,137(15.0%)	5,560
Other orders	172 (3.0%)	1,345 (3.3%)	86 (6.9%)	485 (2.3%)	2,098
Total Insecta	5,652	41,394	1,251	20,960	69,247

TABLE 2. TOTAL CATCH IN RELATION TO TRAP POSITION AT EACH OF THE TWO STUDY SITES ACCORDING TO THE KIND OF TRAP USED.

Trap	Trout Pond		Chi square	Ash Woods		Chi square
Type	Pos. A	Pos. B	Value	Pos. A	Pos. B	Value
Commercial	3,337	2,315	184.8*	595	656	3.0
Townes	24,857	16,527	1,676.7*	10,201	10,759	14.9*
Combined Traps	28,194	18,842	1,859.9*	10,796	11,415	17.3*

*Significantly different, p<.001.

DISCUSSION

Two facts emerge from this study. First, regardless of trap position or placement, the Townes traps were vastly superior to the commercial model by every measure of collecting efficiency. Second, even a relatively small change in trap placement resulted in large differences in collection efficiency.

It is well known that insect flight tends to be concentrated along certain natural corridors such as streams, ecotones, and woodland paths. For Malaise traps to be maximally effective, they should be located in such flyways. The narrow nature of these flight corridors is well illustrated by our data. Although at each site we attempted to place both traps within a single flyway, the two side-by-side locations still differed significantly in numbers of insects obtained. These data underscore the caution with which researchers should attempt any use of Malaise traps for comparing different habitats.

The variables that make one trap design more efficient than another are as yet poorly understood. Because of differences in the size of the trap openings, the commercial trap would superficially appear to sample a larger air space ($4m^2$) than the Townes trap($3m^2$). However, the four-sided design of the commercial trap probably makes such a comparison misleading. When such Malaise traps are placed in a flyway, the two sides parallel to the insect flight path are probably nearly functionless. Thus, the effective air space of the trap is more likely to be on the order of $2m^2$ than $4m^2$. However, even when our commercial trap data are corrected for this, the Townes traps remain superior in numbers of insects caught.

Trap color is known to affect catch (Roberts, 1970,1975; Townes, 1972). The bicolor design of the Townes trap probably increased its effectiveness. Green traps have been shown to trap fewer tabanid flies than natural saran (Roberts, 1970). Further studies on this aspect of trap design might be enlightening.

In our comparison, the shape of the trap openings which intercept insect flight may also have been a major contributing factor to the differences obtained. In the Townes model, these openings are roughly rectangular, whereas in the commercial trap they are triangular. Thus, while both traps intercept much the same area at ground level, they differ more and more at higher levels. (Thus, one would expect a more detailed analysis of our comparative data to reveal that the commercial trap weighted samples in favor of those species that tend to fly close to the ground.)

The bias inherent in the triangular trap opening of the commercial trap probably also has seasonal implications. If height of insect flight above the ground varies according to seasonal temperature (Townes, 1962), the differences in trap efficiency would be accentuated during the warmest periods when insect flight traffic is concentrated higher above the soil. Support for this idea comes from our use of these commercial traps continuously over 13 weeks in Summer 1967 (see Fig. 2, Matthews and Matthews, 1970) in the same positions and locations as those reported here; the greatest numbers of insects were captured during the early weeks of summer, declining as the climate warmed.

ACKNOWLEDGEMENTS

This research was supported by the E. N. Huyck Preserve, Rensselaerville, New York. We extend our grateful appreciation to the Preserve staff, and especially to Dr. Robert Dalgleish and Sally Hoyt. Special thanks to Wayne Gardner, Kathryn Jablonski, Ken Suarez, Kent Palmer, and Mikko Bojarsky, enthusiastic members of two EARTHWATCH teams who assisted in this study.

LITERATURE CITED

Gressitt, J. L. and M. K. Gressitt. 1962. An improved Malaise trap. Pacific Insects 4: 87-90.

Matthews, R. W. and J. R. Matthews. 1970. Malaise trap studies of flying insects in a New York mesic forest. I. Ordinal composition and seasonal abundance. J. N.Y. Ent. Soc. 78: 52-59.

______________ 1971. The Malaise trap: Its utility and potential for sampling insect populations. Mich. Ent. 4: 117-122.

Roberts, R. H. 1970. Color of Malaise trap and the collection of Tabanidae. Mosq. News 30: 567-571.

______________ 1975. Influence of trap screen age on collections of tabanids in Malaise traps. Mosq. News 35: 538-539.

Steyskal, G. C. 1981. A bibliography of the malaise trap. Proc. Ent. Soc. Wash. 83: 225-229.

Townes, H. 1962. Design for a Malaise trap. Proc. Ent. Soc. Wash. 64: 253-262.

______________ 1972. A light-weight Malaise trap. Ent. News 83: 239-247.